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U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF VEGETABLE PATHOLOGY.
BULLETIN No. 7.

THE EFFECT OF SPRAYING

IMPERIAL BUREAU
28 APR 1926

WITH

FUNGICIDES ON THE GROWTH OF NURSERY STOCK.

BY

B. T. GALLOWAY.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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PUBLICATIONS OF THE DIVISION OF VEGETABLE PATHOLOGY.

The Division of Vegetable Pathology, formerly a section of the Division of Botany, became a separate organization by act of Congress approved July 14, 1890. Since that date its bulletins have been numbered independently and in a separate series, but the following list includes the publications of the Division under its former as well as under its present organization. Nos. 1, 3, 4, and 6, omitted from the series of bulletins published by the Section of Vegetable Pathology, are publications of the Division of Botany, not relating to vegetable pathology. Only those documents marked with an asterisk are still on hand for distribution.

SECTION OF VEGETABLE PATHOLOGY, DIVISION OF BOTANY.

Journal of Mycology:

Vol. V, Nos. 1, 2, 3, 4. Pp. 249, pls. 14. 1889–'90.
Vol. VI, No. 1. Pp. 44, pls. 2. 1890.

Bulletins:

No. 2. Report on the Fungous Diseases of the Grapevine. Pp. 136, pls. 7. 1886.
No. 5. Report on the Experiments made in 1887 in the Treatment of the Downy Mildew and the Black Rot of the Grapevine. Pp. 113, Pls. 2, figs. 24. 1888.
No. 7.* Black Rot. Pp. 29, pl. 1. 1888.
No. 8.* A Record of Some of the Work of the Division. Pp. 67. 1889.
No. 9. Peach Yellows: A Preliminary Report. Pp. 254, pls. 37, maps and diagrams 9. 1888.
No. 10. Report on the Experiments made in 1888 in the Treatment of the Downy Mildew and the Black Rot of the Grapevine. Pp. 61, pls. 2. 1889.
No. 11. Report on the Experiments made in 1889 in the Treatment of the Fungous Diseases of Plants. Pp. 119, pls. 8. 1890.

Circulars:

No. 1. Treatment of the Downy Mildew and the Black Rot. Pp. 3. 1886.
No. 2. Grapevine Mildew and Black Rot. Pp. 3. 1886.
No. 3. Treatment of Grape Rot and Mildew. Pp. 2. 1887.
No. 4.* Treatment of the Potato and Tomato for the Blight and Rot. Pp. 3. 1887.
No. 5. Fungicides or Remedies for Plant Diseases. Pp. 10. 1888.
No. 6.* Treatment of Black Rot of the Grape. Pp. 3. 1888.
No. 7.* Grapevine Diseases. Pp. 4. 1889.
No. 8. Experiments in the Treatment of Pear Leaf Blight and the Apple Powdery Mildew. Pp. 11. 1889.
No. 9. Root Rot of Cotton. Pp. 4. 1889.

DIVISION OF VEGETABLE PATHOLOGY.

Journal of Mycology:

Vol. VI, Nos. 2.* 3,* 4.* Pp. 45–207, pls. 16. 1890–'91.
Vol. VII, Nos. 1, 2, 3. Pp. 331, pls. 31. 1891–'93.

Bulletins:

No. 1.* Additional Evidence on the Communicability of Peach Yellows and Peach Rosette. Pp. 65, pls. 39. 1891.
No. 2.* The California Vine Disease. Pp. 222, pls. 27. 1892.
No. 3. Report on the Experiments made in 1891 in the Treatment of Plant Diseases. Pp. 76, pls. 8. 1892.
No. 4.* Experiments with Fertilizers for the Prevention and Cure of Peach Yellows, 1889–'92. Pp. 197, pls. 33. 1893.
No. 5.* The Pollination of Pear Flowers. Pp. 110, pls. 12. 1894.
No. 6. Bordeaux Mixture as a Fungicide (in press).

Farmers' Bulletins:

No. 4.* Fungous Diseases of the Grape and their Treatment. Pp. 12. 1891.
No. 5.* Treatment of Smuts of Oats and Wheat. Pp. 8, pl. 1. 1892.
No. 7.* Spraying Fruits for Insect Pests and Fungous Diseases. Pp. 20. 1892.
No. 15.* Some Destructive Potato Diseases. Pp. 8, figs. 3. 1894.
No. 17.* Peach Yellows and Peach Rosette. Pp. 20, figs. 7. 1894.

Circulars:

No. 10.* Treatment of Nursery Stock for Leaf Blight and Powdery Mildew. Pp. 8, figs. 3. 1891.
No. 11.* Inquiry on Grape Diseases and their Treatment. P. 1. 1891.
No. 12.* Inquiry on Rust of Cereals. P. 1. 1891.
No. 13.* Inquiry on Peach Leaf Curl. Pp. 3. 1893.
No. 14.* Inquiry on Rusts of Cereals. Pp. 3. 1894.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PATHOLOGY,
Washington, D. C., June 5, 1894.

SIR: I have the honor to transmit herewith Bulletin No. 7 of this Division, embodying the results of three years' work in the treatment of nursery stock for the prevention of fungous diseases. The results, it is believed, will be of interest, as they show approximately the cost of the work and the profits of the same. That the work has been of practical value is shown by the interest of the owners of the nursery where the experiments were carried on. During the past three years there have been treated in this nursery alone more than a million pear, plum, cherry, and apple trees. Spraying at this time is looked upon by the owners of the nursery in question as a necessity, and equal in importance to cultivation or fertilization of the soil.

Respectfully,

B. T. GALLOWAY,
Chief of Division.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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THE EFFECT OF SPRAYING WITH FUNGICIDES ON THE GROWTH OF NURSERY STOCK.

THREE SEASONS' WORK AT MULLIKIN, MD., IN TREATING PEAR, CHERRY, PLUM, AND OTHER STOCK.

INTRODUCTION.

Nursery stock, especially pears, cherries, plums, and apples, is subject to several fungous diseases, which attack the foliage, causing the latter to lose its vigor and fall prematurely, or dry up and become useless to the plant. The diseases attacking the pear, cherry, and plum are commonly known as leaf blights, while the one affecting the apple has received the name of powdery mildew.

The fungi causing the diseases in question have, for the most part, been quite fully described in other publications of the Division, consequently it hardly seems necessary to enter upon a discussion of this part of the subject here. Suffice it to say that the fungus causing leaf blight of the pear* is distinct from the one which attacks both the cherry and plum,† while the powdery mildew fungus‡ differs botanically from both of the foregoing, and, as pointed out, its effects on the plant are also different. All the diseases mentioned attack both seedlings and budded or grafted stocks, and as a result the following are some of the principal effects produced: (1) In case of seedlings the active wood ripens so that the buds can not be inserted, or if they are inserted the union with the stock is imperfect and in consequence the bud eventually dies; (2) if the bud or graft should grow, its development is checked by the annual early loss or drying up of its leaves. This brings about a stunted development, from which it is doubtful if the tree ever fully recovers.

Experiments in 1889 and 1890 by the writer showed that the diseases in question could be largely prevented by the proper application of fungicides, but the work as carried on was of such a nature that the full benefit of the treatments could not be ascertained. To accomplish this as nearly as possible a series of experiments was begun in the nurseries of Franklin Davis & Co., at Mullikin, Md., in the spring of 1891 and completed in the autumn of 1893.

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* *Entomosporium maculatum* Lév.

† *Cylindrosporium padi* Karst.

‡ *Podosphæra oxyacanthæ* (DC.) De Bary.

OBJECT AND PLAN OF THE WORK.

The work had for its object primarily the obtaining of some definite information as regards the effect on the growth of the trees of applying fungicides, beginning with the seedling or cutting and continuing until the budded trees were 2 years old. Incidentally it was thought the experiments would throw some light on the question of the relative value of the various stocks so far as resistance to disease and effect on the growth of the bud were concerned. It was arranged that the treatments should begin with the seedling and continue each year until the tree was of salable size. The first year different stocks were to be budded at the usual time, the buds of at least three varieties being inserted in each kind of stock, and careful records were to be kept of the growth of both treated and control seedlings, their condition at budding time, the number of buds inserted, and the number of buds which "took." An account was also to be kept of the number and date of the treatments, as well as the time required in making the applications and the amount of material used. The second year's observations were to be made on the growth of the budded stocks, the behavior of the different varieties so far as resistance to disease was concerned, the time occupied in making the treatments, and the amount of material used. The third and last year, or when the budded stock was 2 years old, careful notes and measurements were again to be made of the growth, the time and material were again to be taken into account, and finally the stock was to be carefully graded and photographed.

It was hoped that by following this plan it would be possible at the end of the experiment to settle two practical points with a reasonable degree of accuracy, namely, (1) the cost of treating the various kinds of stock, and (2) the profit or loss resulting from such treatment. A detailed plan of the experiment, as well as the results of the first year's work, has already been described,* but for the sake of clearness it may be well to briefly review this part of the subject. For the experiment as a whole 6,000 seedlings and cuttings were used, as follows:

Japan pear seedlings	1,000
French pear seedlings	2,000
Cherry stocks (Mahaleb)	500
Apple seedlings	2,000
Plum stocks (Marianna)	500

The stocks were planted in a piece of ground 700 feet long by 21 feet wide, the block as a whole being divided into thirty-three plats, in such a way as to insure as nearly as possible uniformity in soil conditions and cultivation for all the trees.

The fungicides used in the work were as follows: Bordeaux mixture, containing 6 pounds of copper sulphate and 4 pounds of lime to 22 gallons of water; ammoniacal solution of copper carbonate, consisting

* Division of Vegetable Pathology Bull. No. 3, U. S. Department of Agriculture.

of 3 ounces of copper carbonate dissolved in 1 quart of ammonia and diluted with water to 30 gallons; and potassium sulphide solution, made by dissolving 2½ ounces of potassium sulphide in 10 gallons of water. The applications were made with a knapsack pump and Vermorel nozzle, and were so arranged the first year that some of the stocks were sprayed seven times, some six times, and some five times. The reason for adopting this plan was to determine (1) the effects of early treatments on leaf blight, and (2) the effects of treatment up to the time of budding compared with those continued a month after the buds were inserted.

As already pointed out, every plat was budded with three varieties, the object being to obtain for future work stocks susceptible, moderately susceptible, and resistant to disease. For pears, Tyson, Lawrence, and Kieffer were selected; for cherries, Early Purple, Governor Wood, and Black Tartarian; for plums, German Prune, Shippers Pride, and Lombard; and for apples, Rome Beauty, Ben Davis, and C. R. June, the resistant qualities of each variety being in the order named. The details of the work, including planting, budding, grading, spraying, photographing, etc., were either done by my assistant, Mr. P. H. Dorsett, or carried on under his supervision.

RESULTS OF THE FIRST YEAR'S WORK (1891).

The treatments the first season on the plats receiving seven sprayings were made May 5 and 19, June 1 and 16, July 3 and 21, and August 10. The plats receiving six treatments were sprayed May 19, June 1 and 16, July 3 and 21, and August 10; while the plats receiving five treatments were sprayed the same as those receiving seven, excepting the last two sprayings, which were omitted, budding having commenced on July 21. Up to the time of budding, leaf blight caused little damage, this being unusual, especially in the case of pear seedlings.

To obtain the desired information as to the effects of the treatments on the stocks with respect to budding, three grades were established, and as each bud was inserted the stock was referred to its respective grade. The grades were, (1) stocks which worked with ease, i. e., those in which the bark slipped easily; (2) stocks which worked with difficulty; (3) stocks which refused to work. The results of this grading are given in the following table, the number of stocks referred to each grade being given in percentages only.

TABLE 1.—*Showing per cent of treated and control stocks which worked with ease, which worked with difficulty, and which refused to work at budding time, July, 1891.*

Kind of stock.	Kind of treatment.	Worked with ease.	Worked with difficulty.	Refused to work.	Dead.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Japan pear seedlings	Untreated	77	7	10	6
Do	Bordeaux mixture, 5 times	83	9	7	1
Do	Bordeaux mixture, 7 times	73	10	10	7
Do	Ammoniacal solution, 5 times	80	11	6	3
Do	Ammoniacal solution, 7 times	84	6	6	4
Do	Bordeaux mixture, 6 times	78	10	2	10
French pear seedlings	Untreated	83	8	6	3
Do	Bordeaux mixture, 5 times	78	10	10	2
Do	Bordeaux mixture, 7 times	92	4	2	2
Do	Ammoniacal solution, 5 times	82	8	7	3
Do	Ammoniacal solution, 7 times	83	4	9	4
Do	Bordeaux mixture, 6 times	90	2	6	2
Cherry stocks	Untreated	55	7	29	9
Do	Bordeaux mixture, 5 times	68	4	16	12
Do	Bordeaux mixture, 7 times	71	7	9	13
Do	Ammoniacal solution, 5 times	56	16	9	19
Do	Ammoniacal solution, 7 times	67	12	9	12
Apple seedlings	Untreated	85	4	7	4
Do	Bordeaux mixture, 5 times	82	6	10	2
Do	Bordeaux mixture, 7 times	75	7	10	8
Do	Ammoniacal solution, 5 times	82	5	9	4
Do	Ammoniacal solution, 7 times	85	5	6	4
Do	Potassium sulphide, 5 times	91	5	2	2
Do	Potassium sulphide, 7 times	84	5	8	3
Plum stocks	Bordeaux mixture, 5 times	74	16	10	0
Do	Bordeaux mixture, 7 times	45	18	18	19
Do	Ammoniacal solution, 5 times	73	16	2	9
Do	Ammoniacal solution, 7 times	77	14	4	5
Do	Untreated	63	31	5	1

A study of the table as a whole brings out the fact that there were no striking differences between the treated and untreated trees so far as their condition for budding was concerned. In some cases the treatments apparently increased the number of stocks which worked with ease, but the differences were so slight and in some instances so conflicting that they are hardly worthy of notice. As a partial explanation of the facts brought out by the table, it may be said that there was little or no disease of any kind on the stocks up to and including the time of budding. The season was an exceptional one in this respect, as it frequently happens that pear stock is defoliated before budding time arrives. From the time the buds were inserted, however, until frost, pear leaf blight was quite severe, resulting, as will be pointed out further along, in the death of a considerable number of the buds.

After budding, two additional treatments were made to some of the stocks, in accordance with the plan already announced, and then, on August 24, all the pear stocks were examined and separated into four grades as follows:

First quality, all leaves perfect.

Second quality, spotted here and there, but none lost.

Third quality, all leaves showing spots and tree partly defoliated.

Fourth quality, trees entirely defoliated.

The cherry, plum, and apple stocks were not graded, as the effect of the treatment upon them was not sufficiently marked to warrant a close division. There was considerable difference, however, especially in the

case of the plum and cherry stocks. The result of the grading is shown in the accompanying table:

TABLE 2.—*Showing per cent of first, second, third, and fourth qualities, August 24, 1891.*

Kind of stock.	Kind of treatment.	First quality.	Second quality.	Third quality.	Fourth quality.	Dead.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Japan pear seedlings.	Untreated	0	21	29	42	8
Do	Bordeaux mixture, 5 treatments	1	49	30	14	6
Do	Bordeaux mixture, 7 treatments	24	49	12	6	4
Do	Ammoniacal solution, 5 treatments	0	32	39	23	6
Do	Ammoniacal solution, 7 treatments	12	44	23	16	4
Do	Bordeaux mixture, 6 treatments	25	43	20	4	8
French pear seedlings.	Untreated	0	2	17	78	3
Do	Bordeaux mixture, 5 treatments	0	18	61	17	4
Do	Bordeaux mixture, 7 treatments	15	34	11	4	36
Do	Ammoniacal solution, 5 treatments	0	6	34	57	3
Do	Ammoniacal solution, 7 treatments	3	40	38	14	4
Do	Bordeaux mixture, 6 treatments	30	39	31	0	0

It will be seen from the foregoing table that 42 per cent of the untreated Japan pear seedlings and 78 per cent of untreated French pear seedlings were classed as fourth quality. In other words, 42 and

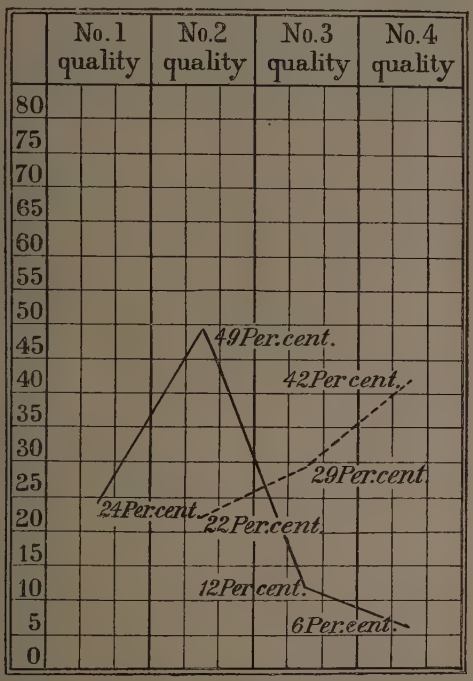

FIG. 1.—Diagram illustrating the effects of spraying Japan pear seedlings with Bordeaux mixture seven times as compared with no treatment. Continuous line represents the sprayed trees, broken line the unsprayed.

78 per cent, respectively, of the untreated Japan and French seedlings were totally defoliated on August 24. The Japan pear seedlings treated five times with Bordeaux mixture gave only 14 per cent fourth quality,

while those treated seven times with the same fungicide showed but 6 per cent totally defoliated. Bordeaux mixture, it will be seen, gave, with one exception, better results than ammoniacal solution of copper carbonate. A further study of the table, especially the columns giving first and second quality, brings out other points of interest. For example, where Bordeaux mixture was applied seven times there were 24 and 15 per cent, respectively, of the Japan and French seedlings which showed no disease whatever. The more important results are shown graphically by the accompanying diagrams (figs. 1 and 2).

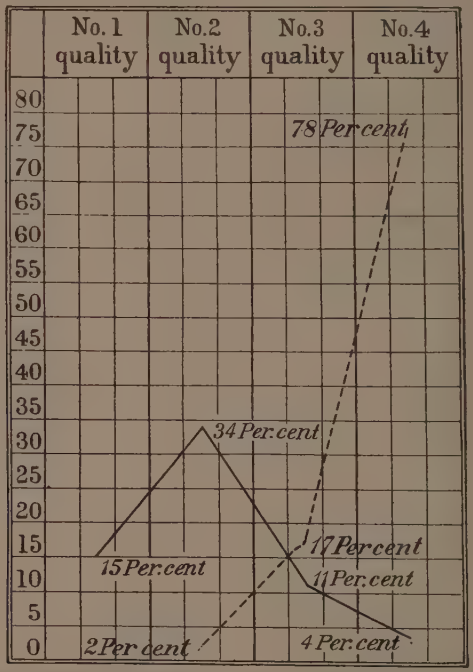

FIG. 2.—Diagram illustrating the effects of spraying French pear seedlings with Bordeaux mixture seven times as compared with no treatment. Continuous line represents the sprayed trees, broken line the unsprayed.

A study of these diagrams brings out the points of interest very strikingly. Taking the unbroken curve for the treated trees in fig. 1, for example, it is seen that 24 per cent of the trees are first quality, 49 per cent are second quality, 12 per cent are third quality, and only 6 per cent fourth quality. The ideal curve, of course, would be one abruptly and continuously downward from the top of column 1. In other words, this would mean that nearly all of the trees were of first quality.

In the curve for the untreated trees the start is made at 22 per cent in the second column, and then there is a constant tendency upward,

or away from the ideal. The poorer the quality, in other words, the greater the number of trees. In fig. 2 there is a striking dissimilarity in the curves. For the treated there is 15 per cent first quality, 34 per cent second quality, 11 per cent third quality, and 4 per cent fourth quality. That is to say, after the second column is reached the tendency is downward or toward the ideal. On the other hand, the curve for the untreated is abruptly upward, passing from 2 per cent of second quality to 17 per cent of third quality, and thence to 78 per cent of fourth quality.

RESULTS OF THE SECOND YEAR'S WORK (1892).

Before beginning the treatments in 1892 all the budded stock was cut back, leaving, as is usually the case in nurseries, only the stump containing the dormant bud inserted the previous summer. The ground was then plowed and put in condition to insure a vigorous growth of the trees. All of the plats received the same number of sprayings this year as in 1891. The plats which received seven sprayings in 1891 were treated on May 24, June 4 and 16, July 7 and 23, and August 10 and 30, respectively; those which received six sprayings in 1891 were treated on June 4 and 14, July 7 and 23, and August 10 and 30, respectively; while those treated five times received the applications on May 24, June 4 and 16, and July 7 and 23, respectively. At the time of the second spraying there were several points of interest noted in connection with the work. To obtain accurate information on this matter the trees were all separately examined and graded, (1) according to whether the bud was living or dead, (2) according to the growth of the bud, and (3) according to the presence or absence of disease on the buds which had started.

Summarizing the data thus obtained, it may be said that the examination and grading showed that in the case of the pears, from 10 to 20 per cent of the buds inserted in trees receiving no treatment died, while in case of the treated trees the number which died in no instance exceeded 12 per cent. Next to the pears, the plums and cherries showed the effects of the treatments most decisively. There was very little difference between the treated and untreated apples so far as the number of buds which grew and the growth of the buds were concerned. Bordeaux mixture in all cases gave the best results, the effects of this preparation on the growth of the pears being very marked.

On July 23 the height of all the stock was measured and these measurements represent the growth of the bud from the time it started in spring up to the date mentioned. The measurements showed that the pear trees treated with Bordeaux mixture were from 10 to 15 per cent larger than the untreated. In case of the plums, cherries, and quinces, the differences were not so great, averaging not more than 5 per cent in favor of the treated. For the apples the differences were so slight as to be inappreciable.

RESULTS OF THE THIRD YEAR'S WORK (1893).

The plats which received seven treatments in 1891 and 1892 were sprayed six times in 1893, while those which received six and five treatments, respectively, in the years mentioned, were sprayed five times. The dates for the six treatments were May 13 and 24, June 7 and 20, and July 6 and 25, respectively. The plats which received six applications in previous years were this season treated on May 24, June 7 and 20, and July 6 and 25, respectively, while those which in previous years had received five applications were sprayed this season on May 13 and 24, June 7 and 20, and July 6, respectively.

All budded stocks had been properly pruned and those in which the buds refused to grow had been dug out. At this time there was a marked difference between the treated and untreated pear stocks. In the case of the plums and cherries, the difference between the treated and untreated trees could also be easily discerned. The apple stocks

FIG. 3.—Tyson pear on Japan stocks, untreated; budded July, 1891, and photographed October, 1893.

showed no appreciable differences; in fact this condition of affairs prevailed with the apples throughout the experiment. Detailed notes on the appearance of the leaf-blight fungi, their effects on the stocks, the time required in spraying, and the amount of material used were made from time to time in order to carry out the plan as set forth at the beginning of this bulletin.

On October 20, careful notes were made on all the trees, and a set of representative ones from the more important plats were photographed. The photographs are reproduced in the accompanying illustrations, the height of the trees being shown by the ruled stake at the side.

A large number of the untreated Tyson pears on Japan stocks were dead, the condition of those remaining being very clearly shown in the

illustration. The height of the untreated trees varied from 2 to 3 feet and the caliper from one-fourth to three-eighths of an inch.

FIG. 4.—Tyson pear on Japan stocks, treated seven times with Bordeaux mixture in 1891 seven times in 1892, and six times in 1893. Strictly comparable with fig. 3.

FIG. 5.—Tyson pear on Japan stocks, treated with ammoniacal solution of copper carbonate seven times in 1891, seven times in 1892, and six times in 1893.

The Tyson on Japan stocks treated with Bordeaux mixture (fig. 4) show a striking contrast to the untreated. The trees averaged 5 to 6 feet in height and calipered almost uniformly three-fourths of an inch.

These trees averaged much better than the untreated, but were not so good as those sprayed with Bordeaux mixture. The stock treated

FIG. 6.—Tyson pear on French stocks, untreated; budded July, 1891, and photographed October, 1892.

with ammoniacal solution of copper carbonate five times in 1891, five times in 1892, and five times in 1893 did not differ from that shown in fig. 5.

FIG. 7.—Tyson pear on French stocks, treated with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893; budded and photographed the same as set forth in the explanation to fig. 6.

The remarkable effects of the treatments on the growth of the trees is strikingly shown by the two illustrations, figs. 6 and 7. It would

take at least two years more to grow the untreated trees to the size of the treated. As a whole the Tyson on French stocks made a better growth than those on Japan stocks, the size of the trees, especially those treated, averaging greater, besides being more even.

FIG. 8.—Tyson pear on French stocks, treated with ammoniacal solution of copper carbonate five times in 1891, five times in 1892, and five times in 1893; budded July, 1891, and photographed October, 1893.

The Tyson trees on French stocks sprayed with ammoniacal solution of copper carbonate, as given in the explanation to fig. 8, were better

FIG. 9. Kieffer pear on Japan stocks, untreated; budded July, 1891, and photographed October, 1893.

than the untreated, but not nearly so good as those sprayed with Bordeaux mixture.

The best growth of any of the stock was made by the Kieffers (figs. 9 and 10). Even in this strong-growing variety, however, the treated trees were much superior to the untreated.

FIG. 10.—Kieffer pear on Japan stocks, treated with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893; budded and photographed the same as the trees shown in fig. 9.

There was very little difference between the Kieffer on Japan (figs. 9 and 10) and the Kieffer on French stocks (figs. 11 and 12). The former made a slightly stronger growth, but not enough to be markedly appreciable.

FIG. 11.—Kieffer pear on French stocks, untreated; budded July, 1891, and photographed October, 1893.

FIG. 12.—Kieffer pear on French stocks, treated five times with Bordeaux mixture in 1891, five times in 1892, and five times in 1893; budded July, 1891, and photographed October, 1893.

The photographs reproduced in figs. 13 and 14 show the effects of the treatments in case of the Black Tartarian cherry. In the other varieties of cherry the differences were not so striking. After the photographs were made all the trees were carefully examined and separated into four grades as follows:

Two-year apples, plums, and pears.—Extra: Caliper, three-fourths to seven-eighths inch; height, 4 to 6 feet; well branched. First-class: Caliper, five-eighths inch; height, 4 to 6 feet; sparingly branched. Medium: Caliper, one-half inch; height, 3 to 5 feet; few or no branches. Small: Caliper, three-eighths inch; height, 2 to 3 feet; no branches.

FIG. 13.—Black Tartarian cherry, untreated; budded July, 1891, and photographed October, 1893.

Two-year cherries.—Extra: Caliper, three-fourths inch; height, 5 to 6 feet; well branched. First class: Caliper, five-eighths inch; height, 4 to 5 feet; well branched. Medium: Caliper, five-eighths inch; height, 3½ to 4½ feet; few or no branches. Small: Caliper, one-half inch; height, 2 to 3 feet; no branches.

While these grades are to a certain extent arbitrary, they show, in a comparative way, the condition of the trees. In the following table

FIG. 14.—Black Tartarian cherry, treated with Bordeaux mixture five times in 1891, five times in 1892, and 5 times in 1893; budded and photographed the same as given in explanation to fig. 13.

is given the number of trees in the various grades, together with the percentages in each case:

TABLE 3.—*Showing number and per cent of trees in various grades, October, 1893.*

No. of plat.	Kind of stock.	Kind of treatment.	Number of sprayings in—			Variety budded.	Number of trees.	Grades of stock—				Percentage of each grade—			
			1891.	1892.	1893.			Extra.	First class.	Medium.	Small.	Extra.	First class.	Medium.	Small.
1	Japan	Untreated		None.		Tyson	54	0	7	7	40	0	13	13	74
1	do	do		None.		Lawrence	91	2	3	12	74	2	3	13	82
1	do	do		None.		Kieffer	77	7	16	20	34	9	21	26	44
2	do	Bordeaux mixture	5	5	5	Tyson	26	1	4	7	14	4	15	27	54
2	do	do	5	5	5	Lawrence	30	2	3	4	21	7	10	13	70
2	do	do	5	5	5	Kieffer	34	16	9	5	4	47	26	15	12
3	do	do	7	7	6	Tyson	34	2	12	1	19	6	35	3	56
3	do	do	7	7	6	Lawrence	31	5	12	5	9	16	39	16	29
3	do	do	7	7	6	Kieffer	25	13	8	1	3	52	32	4	12
4	do	Ammoniacal solution	5	5	5	Tyson	32	1	2	3	26	3	6	10	81
4	do	do	5	5	5	Lawrence	30	1	0	5	24	3	0	17	80
4	do	do	5	5	5	Kieffer	29	7	6	4	12	24	21	14	41
5	do	do	7	7	6	Tyson	33	1	12	12	8	3	36	37	24
5	do	do	7	7	6	Lawrence	34	6	4	7	17	18	12	20	50
5	do	do	7	7	6	Kieffer	26	8	6	7	5	31	23	27	19
6	do	Bordeaux mixture	6	6	5	Tyson	27	4	8	4	11	15	30	15	40
6	do	do	6	6	5	Lawrence	19	0	3	2	14	0	16	10	74
6	do	do	6	6	5	Kieffer	30	2	11	9	8	6	37	30	27
7	French	Untreated		None.		Tyson	169	0	1	1	167	0	0	1	99
7	do	do		None.		Lawrence	174	0	0	15	159	0	0	9	91
7	do	do		None.		Kieffer	93	7	19	41	26	8	20	44	28
8	do	Bordeaux mixture	5	5	5	Tyson	58	3	10	16	29	5	17	28	50
8	do	do	5	5	5	Lawrence	61	0	7	16	38	0	12	26	62
8	do	do	5	5	5	Kieffer	49	15	8	16	10	31	16	33	20
9	do	do	7	7	6	Tyson	73	18	29	14	12	25	40	19	16
9	do	do	7	7	6	Lawrence	67	7	23	18	19	10	34	27	29
9	do	do	7	7	6	Kieffer	66	24	23	8	11	36	35	12	17
10	do	Ammoniacal solution	5	5	5	Tyson	45	1	0	7	37	2	0	16	82
10	do	do	5	5	5	Lawrence	84	0	2	17	65	0	2	20	78
10	do	do	5	5	5	Kieffer	83	7	12	19	45	8	14	24	54
11	do	do	7	7	6	Tyson	58	0	7	21	30	0	12	36	52
11	do	do	7	7	6	Lawrence	58	4	10	19	25	7	17	33	43
11	do	do	7	7	6	Kieffer	48	5	20	17	6	10	42	36	12
12	do	Bordeaux mixture	6	6	5	Tyson	52	8	14	2	28	15	27	4	54
12	do	do	6	6	5	Lawrence	34	2	2	7	23	5	5	20	70
12	do	do	6	6	5	Kieffer	46	7	7	8	24	16	15	17	52
13	Cherry	Untreated		None.		Early Purple	9	5	3	1	0	56	33	11	0
13	do	do		None.		Gov. Wood	10	6	1	1	2	60	10	10	20
13	do	do		None.		Black Tartarian	17	8	3	3	3	47	18	18	17
14	do	Bordeaux mixture	5	5	5	Early Purple	13	6	3	3	1	46	23	23	8
14	do	do	5	5	5	Gov. Wood	7	4	1	1	1	57	15	14	14
14	do	do	5	5	5	Black Tartarian	10	9	1	0	0	90	10	0	0

15	do	do	7	7	6	Early Purple	9	9	0	0	0	100	0	0	0
15	do	do	7	7	6	Gov. Wood	9	8	0	1	0	89	0	11	0
15	do	do	7	7	6	Black Tartarian	10	9	1	0	0	90	10	0	0
16	do	Ammoniacal solution	5	5	5	Early Purple	4	2	1	0	1	50	25	0	25
16	do	do	5	5	5	Gov. Wood	10	8	1	1	0	80	10	10	0
16	do	do	5	5	5	Black Tartarian	7	7	0	0	0	100	0	0	0
17	do	do	7	7	6	Early Purple	4	3	1	0	0	75	25	0	0
17	do	do	7	7	6	Gov. Wood	6	6	0	0	0	100	0	0	0
17	do	do	7	7	6	Black Tartarian	14	11	1	0	2	79	7	0	14
30	Plum	Bordeaux mixture	5	7	7	German Prune	12	11	1	0	0	92	8	0	0
30	do	do	5	7	7	Shippers Pride	15	11	0	0	4	73	0	0	27
30	do	do	5	7	7	Lombard	11	9	2	0	0	82	18	0	0
31	do	do	7	7	6	German Prune	11	10	1	0	0	91	9	0	0
31	do	do	7	7	6	Shippers Pride	13	9	2	0	2	70	15	0	15
31	do	do	7	7	6	Lombard	12	11	0	0	1	92	0	0	8
32	do	Ammoniacal solution	5	5	5	German Prune	15	8	3	1	3	53	20	7	20
32	do	do	5	5	5	Shippers Pride	20	15	5	0	0	75	25	0	0
32	do	do	5	5	5	Lombard	14	12	2	0	0	86	14	0	0
33	do	do	7	7	6	German Prune	20	15	2	2	1	75	10	10	5
33	do	do	7	7	6	Shippers Pride	18	11	3	0	4	61	17	0	22
33	do	do	7	7	6	Lombard	18	15	1	1	1	83	0	6	5
34	do	Untreated	None.			German Prune	23	16	3	1	3	70	13	4	13
34	do	do	None.			Shippers Pride	22	19	2	1	0	86	9	5	0
34	do	do	None.			Lombard	30	23	4	2	1	77	13	7	3

Although the foregoing table is unavoidably somewhat complicated, a study of its figures brings out a number of interesting points. Taking the Tyson pear, for example, in plat 1, untreated, it is seen that of "extra" trees there were none, of "first-class" there were 13 per cent, "medium" 13 per cent, and "small" 74 per cent. Comparing these figures with those shown for the same variety in plat 3, treated 7 times in 1891, 7 times in 1892, and 6 times in 1893 with Bordeaux mixture, we find "extra" 6 per cent, "first-class" 35 per cent, "medium" 3 per cent, and "small" 56 per cent.

In fig. 15, given below, the results in case of the Tyson pear on Japan stocks, treated and untreated, are graphically illustrated.

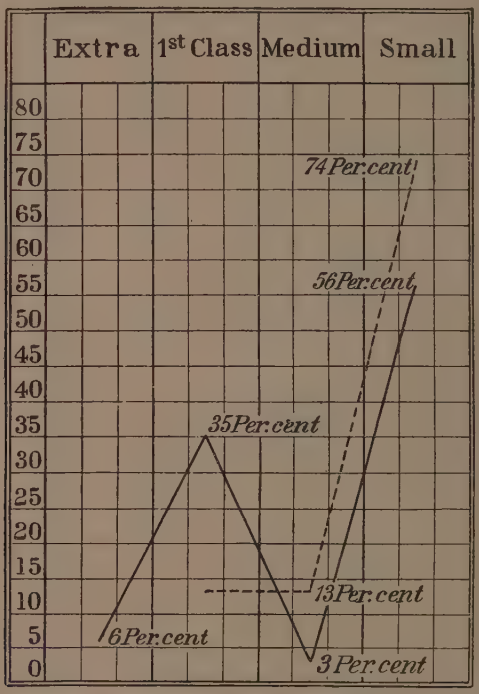

FIG. 15.—Diagram illustrating the effect of treating Tyson pear on Japan stocks with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893. Continuous line represents the treated trees, broken line the untreated.

The differences as shown by the curves, while not very striking, bring out some points of interest. The curve for the sprayed trees starts at 6 per cent in column 1, "extra" trees, and rises to 35 per cent in column 2, "first-class" trees; falls again to 3 per cent in column 3, "medium" trees; and then rises again to 56 per cent in column 4, "small" trees. The curve for the untreated trees shows nothing in

column 1, "extra" trees and only 13 per cent in column 2, "first-class" trees. It then passes to 13 per cent in column 3, "medium" trees, and thence to 74 per cent in column 4, "small" trees. Seventy-four per cent of the untreated trees, in other words, were graded as "small," while the remaining 26 per cent were divided equally among the "medium" and "first-class" trees.

A comparison of the treated and untreated Kieffer pear on Japan stocks shows somewhat more striking results, as will be seen from the accompanying diagram (fig. 16).

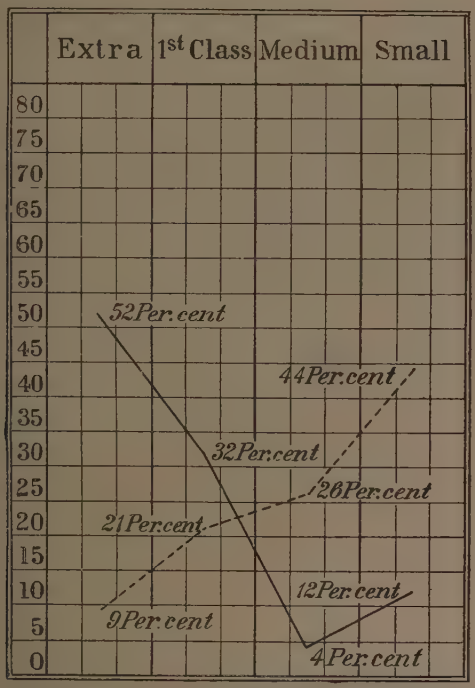

FIG. 16.—Diagram illustrating the effects of treating Kieffer pear on Japan stocks with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893. Continuous line represents treated trees, broken line the untreated.

The curve in the case of the treated trees, as will be seen, is almost constantly downward or toward the ideal, while the one for the unsprayed trees is constantly upward or away from the ideal. One of the most striking effects of the work is shown in the next diagram (fig. 17), sprayed and unsprayed cherry trees.

In this case there is for the treated trees an absolutely ideal curve. Every one of the trees, in other words, was classified as "extra." The

curve for the untreated trees was toward the ideal, starting at 56 per cent in column 1, "extra," and ending at 11 per cent in column 3, "medium."

Other cases show more strikingly in favor of the treatments, and still others show a difference in favor of no treatments. These matters, however, will be more fully referred to under the next heading.

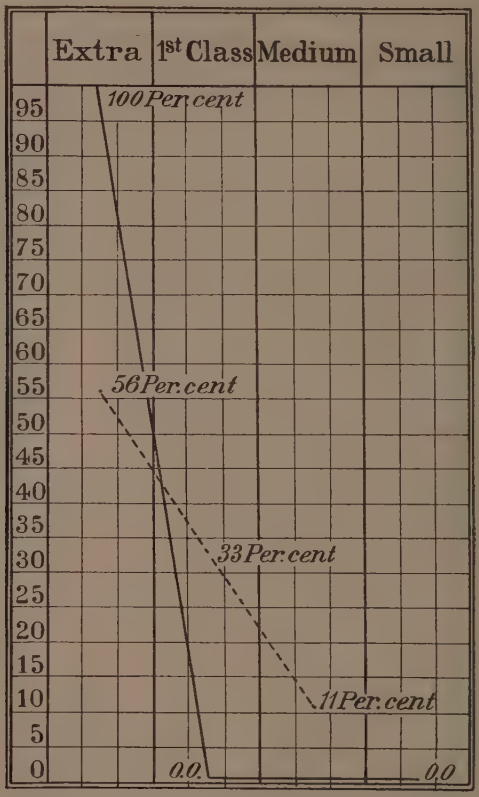

FIG. 17.—Diagram illustrating the effects of treating Early Purple cherry with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893. Continuous line represents the treated trees, broken line the untreated.

COST AND PROFIT OF THE WORK.

In an experiment such as is here described it would be difficult to fairly estimate the cost of treating each year the various kinds of trees under consideration. There are so many delays from one cause or another that figures based upon the actual time expended in the work would be misleading. In estimating the cost, therefore, we have decided to go outside of the actual experiment for data. In the nursery proper,

where the experiments were carried on, from 500,000 to 800,000 trees, including pear, apple, cherry, and plum, are sprayed each year. In this work three kinds of spraying machines have been used, namely, (1) knapsack pumps: (2) machines drawn by horse power, but operated by hand; (3) automatic machines, drawn and operated by horse power. With the last, three men can spray about 100,000 seedlings a day. Using such a machine and taking the facts brought out by the experiment proper as a basis, together with the average price paid for labor and chemicals, it is believed a fair estimate of the cost of treating pear, plum, and cherry stock the first year, or before and after the buds are inserted, will be about 25 cents for 1,000 trees. The next year, or when the buds are making their first season's growth, the cost of the work will probably not exceed 25 cents, while the following season, or the second year from the bud, the cost will be increased 10 to 15 cents, or about 40 cents per 1,000. On this basis the entire cost of treating trees until they are 2 years old from the bud will range from 85 cents to $1 per 1,000, or about 1 mill per tree.

Turning our attention now to the matter of profit as a result of the work, it may be said that here we have another more or less difficult and complicated question to deal with. Of necessity the figures in this case are based entirely on the results obtained in the experiment proper; notwithstanding this fact, however, it is believed that the figures underestimate rather than overestimate the matter.

The trees were taken just as they stood, and their value was fixed in accordance with the grading as already described and the prevailing average wholesale price. If the trees could have been treated as a whole, in a large, solid block, there is little doubt that the results would have been more decisive, as the chances for infection would, to a certain extent, have been lessened. As the experiment was carried on, nearly every block of treated trees was surrounded by untreated ones, thus furnishing the severest test for the fungicides.

Turning now to table 4, a consideration of the figures there given, in connection with the average wholesale prices of nursery stock, brings out some interesting facts. Taking plat 1, Tyson pears on Japan stocks, untreated, we find "extra" trees none, "first class" 13 per cent, "medium" 13 per cent, and "small" 74 per cent. On this basis 1,000 trees in the grades given would have the following value in the wholesale market:

TABLE 4.—*Plat 1, untreated.*

Variety.	Quality.	Per cent.	Number of trees.	Price per 1,000	Value of trees.
Tyson on Japan	Extra	0			
Do	First class	13	130	$135	$17.55
Do	Medium	13	130	110	17.55
Do	Small	74	740	85	62.90
Total		100	1,000		98.00

Now, comparing with the foregoing plat 3, Tyson on Japan stocks treated with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893, we find "extra" trees 6 per cent, "first class" 35 per cent, "medium" 3 per cent, "small" 56 per cent. One thousand trees of the various grades mentioned would be worth in the wholesale market as follows:

TABLE 5.—*Plat 3, treated with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893.*

Variety.	Quality.	Per cent.	Number of trees.	Price per 1,000.	Value of trees.
Tyson on Japan	Extra	6	60	$150	$9.00
Do	First class	35	350	135	47.25
Do	Medium	3	30	110	3.30
Do	Small	56	560	85	47.60
Total		100	1,000		107.15

It thus appears that the treated trees would have a market value of $9.15 more per 1,000 than the untreated. Estimating the cost of the work at $1 per thousand, there is a clear profit to the grower of $8.15 per 1,000 trees. However, this is one of the less striking cases, as will be seen by comparing Kieffer pears from plats 1 and 3, which received exactly the same treatments as Tyson. The following are the tables:

TABLE 6.—*Plat 1, untreated.*

Variety.	Quality.	Per cent.	Number of trees.	Price per 1,000.	Value of trees.
Kieffer on Japan	Extra	9	90	$150	$13.50
Do	First class	21	210	135	28.35
Do	Medium	26	260	110	28.60
Do	Small	44	440	85	37.40
Total		100	1,000		107.85

TABLE 7.—*Plat 3, treated with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893.*

Variety.	Quality.	Per cent.	Number of trees.	Price per 1,000.	Value of trees.
Kieffer on Japan	Extra	52	520	$150	$78.00
Do	First class	32	320	135	43.20
Do	Medium	4	40	110	4.40
Do	Small	12	120	85	10.20
Total		100	1,000		135.80

Here we have a difference of $27.95 in favor of the treated trees, or a clear profit of $26.95 per 1,000. In reality there is more of a gain than is actually shown by the figures, for the reason that the "extra" and "first-class" trees are always more readily disposed of than the others; that is, there is usually a ready market for such trees, while it is often difficult to get rid of the "medium" and "small" trees, excepting at a sacrifice.

Probably one other example will suffice to illustrate the point we wish to make, namely, that the work can be done as a rule at a fair profit. Plat 13, Early Purple cherry, received no treatment, and the trees when graded were found to be worth the following:

TABLE 8.—*Plat 13, untreated.*

Variety.	Quality.	Per cent.	Number of trees.	Price per 1,000.	Value of trees.
Early Purple	Extra	56	560	$150	$74.50
Do	First class	33	330	135	44.55
Do	Medium	11	110	110	12.10
Total		100	1,000		131.15

Plat 15, containing the same variety as plat 13, but treated with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893, gave 100 per cent "extra" trees, worth as follows:

TABLE 9.—*Plat 15, treated with Bordeaux mixture seven times in 1891, seven times in 1892, and six times in 1893.*

Variety.	Quality.	Per cent.	Number of trees.	Price per 1,000.	Value of trees.
Early Purple	Extra	100	1,000	$150	$150.00

In this case, as will be seen by a comparison of the figures, there is a difference of $18.85 in favor of the treated trees, or $17.85 clear profit. Without going into further details in regard to this matter, it may be said that, taking the pears, cherries, and plums as a whole, 44 of the treated plats showed a gain in value over the untreated, and 10 of the treated showed a loss as compared with the untreated. The gain in value of the treated plats over those not treated ranged from $1 to $40 per 1,000 trees, the average being $13 per 1,000.

In the case of the 10 treated plats where the trees showed less value than the untreated, the loss ranged from $1 to $18 per thousand trees, and averaged $7 per thousand. The evidence is such as to warrant the statement that in case of the 10 plats which showed a loss the results were due to causes which can not be used as an argument against treatment, except in special cases. To explain, 4 of the plats where a loss occurred contained Shippers Pride plums, and from the outset the foliage of this variety was more or less injured by the sprays. It seems reasonable, therefore, to believe that the susceptibility of Shippers Pride to the injurious action of the fungicides accounts for the results noted. In other words, there are certain varieties whose foliage is likely to be injured by treatments of any kind, and in such cases where the injuries from the use of the fungicides exceed those brought about by the diseases, the value of the treated trees at the end of two or more years will of course be less than those not treated. Difference

in fertility of treated and untreated plants is also a factor that would have to be considered, as well as vigor of stocks and the effect of the stock on the bud.

SUMMARY.

The more important points brought out by the experiment may be briefly summarized as follows:

(1) The treatment had comparatively little effect on the apples; that is, the untreated trees were, from the beginning to the end of the experiment, practically as good as the treated. It must be borne in mind, however, that powdery mildew, the only fungus that seriously interferes with the growth of the apple in the nursery, was almost entirely absent during the progress of the work.

(2) The most striking results of the work were seen in the case of the pears, cherries, and plums, in the order named.

(3) Bordeaux mixture in every instance gave the best results, materially increasing the growth of the pears and cherries, and never in any case injuring the foliage in the slightest. As pointed out in other publications of this Division, the remarkable effect of this mixture can not be wholly accounted for on the ground of its efficiency as a fungicide or insecticide. It certainly possesses qualities aside from those mentioned, and these qualities, when well understood, it is believed will prove of considerable practical importance.

(4) There was no appreciable difference as regards growth between stocks treated early and those treated late. In other words, withholding the application of the fungicide ten to fifteen days in spring did not materially affect the result so far as growth was concerned. In some cases the plats sprayed seven times seemed to be better than those which received five sprayings, but the differences were so slight as to be hardly worthy of notice.

(5) As regards the effect of the stock on the bud, it may be said that the experiments showed nothing striking, excepting that the Japan pear roots in almost every case gave the best growth. An exception to this, however, occurred in case of Tyson, which made the best growth on French roots.

(6) The treatments did not seem to produce any marked effect on stocks so far as rendering them more easily budded. These results may, in a measure, be accounted for, however, by the fact that the leaf-blight diseases were not so severe during the early part of the season of 1891 as usual.

(7) The cost of treating nursery stock with Bordeaux mixture, the only preparation that can be unqualifiedly recommended, need not exceed 25 cents per 1,000 trees the first season. The second year the cost of the work will also be 25 cents, while the third year the cost will be increased to 35 or 40 cents per 1,000, making the total cost of treating trees until the buds are 2 years old from 85 cents to $1 per 1,000.

(8) The net profit resulting from the work in case of the pears and

cherries ranged from $1 to $40 per 1,000 trees, the average being $13 per 1,000.

(9) In conclusion it may be said that as a whole the experiments clearly show that spraying nursery stock with fungicides is thoroughly practicable; that it results in better trees in every way; and finally, that it yields a handsome profit.

THE GROWTH OF PEAR SEEDLINGS AS AFFECTED BY ONE SEASON'S SPRAYING WITH BORDEAUX MIXTURE.

The experiment here described was undertaken for the purpose of determining more accurately than has heretofore been done the effect of spraying with Bordeaux mixture on the growth of Japan and French pear seedlings. In the experiments described in the preceding pages, and in fact wherever such work has been carried on, the effect of the treatments as regards growth has been determined largely by the judgment of one or more individuals. Thus, in the matter of grading, the class to which a tree is referred is fixed by the judgment of the grader, and not by anything like mathematical rules. While results obtained in this way will answer for all ordinary practical purposes, they are not, strictly speaking, accurate. The interest awakened in the question as to the effect of Bordeaux mixture on plants, aside from its action in preventing fungous attacks, has shown the importance of making careful experiments with a view of obtaining some accurate data on the subject.

That the fungicide exerts an influence on the functions of certain plants wholly independent of any action resulting from the prevention of fungous or other parasites, we think can no longer be doubted. This fact was recognized by us in some of the earliest work with the mixture, and has been referred to in several of our reports.*

A number of European investigators† have studied the subject, but

* Section of Vegetable Pathology, Bull. No. 10, U. S. Dept. of Agr., p. 25; Division of Vegetable Pathology, Bull. No. 2, U. S. Dept. of Agr., pp. 200–205; Journal of Mycology, U. S. Dept. of Agr., vol. VII, No. 3, p. 209.

†Muntz, A. Sur le traitement du mildiou par le sulfate de cuivre (Compt. Rend., 1885, Nov. 2, No. 18, pp. 895–897). Sulphate of copper 5:100 was used alone, and seemed to increase the per cent of sugar, but injured the foliage.

Millardet et David. Résultats de divers procédés de traitement sur le développement du mildiou (Jour. d'Agr. Prat., 1886, 50e ann., t. II, pp. 764–770, 831–836, 874–878). Shows that the treatments influence sugar production in the grape.

Cuboni, G. La transpirazione e assimilazione nelle foglie trattate con latte di calce (Malpighia, ann. 1, fasc. 8).

Giard, Aimé. Destruction du *Peronospora schachtii* de la betterave à l'aide des composés cuivriques (Jour. d'Agr. Prat., 1891, t. II, 55e ann., pp. 15, 16). Sugar content increased when Bordeaux mixture was used.

Rumm, C. Ueber die Wirkung der Kupferpräparate bei Bekämpfung der sogenannten Blattfall-Krankheit der Weinrebe (Ber. d. Deut. Bot. Ges., Bd. XI, Heft 2,

their work leaves many points unsettled. We now have under way experiments which, when completed, will, it is hoped, throw light upon many questions of interest.

The work here described does not enable us to determine how much of the increase in growth as noted was due to preventing fungous attacks and how much was brought about by other causes; still, it shows the remarkable effect of the mixture on the growth of pear trees more accurately than has heretofore been done, so far as we are aware.

PLAN OF THE WORK.

One hundred Japan and the same number of French pear seedlings were selected, a special effort being made to have the trees of each variety as uniform as possible in size. Each tree was labeled with a small zinc tag, upon which was stamped the number used throughout the experiment. The trees were then separately examined, and the following points noted:

(1) Total weight of tree.
(2) Total length of tree, including roots.
(3) Total length of tree, excepting roots.
(4) Diameter or caliper at the collar.
(5) Diameter or caliper 6 inches above the collar.
(6) Number of branches.

After obtaining the data in accordance with the foregoing plan, the trees were tied in lots of 10 and shipped to the nursery of Franklin Davis & Co., at Mullikin, Md., where they were planted April 26, 1893. In planting, the trees were set in a single row, and divided into plats of 10 trees each. The trees within the plats were 6 inches apart, while the plats themselves were 3 feet apart. The French and Japan seedlings alternated, and the treatments were made in such a way that 2 plats, 1 of Japan seedlings and 1 of French, were sprayed, and 2 in the same way left unsprayed. The following table will show more clearly the arrangement of the trees and method of treatment:

1893, pp. 79–93; Ibid., Heft 7, pp. 445–452. See also critical reviews by Aderhold in Bot. Zeit., 1893, No. 11, pp. 162, 163; and Zimmermann in Bot. Centralbl., 1893, No. 23, pp. 307, 308; Nos. 29, 30, pp. 119, 120).

Frank, B., and Kruger, F. Ueber den Reiz, welchen die Behandlung mit Kupfer auf die Kartoffelpflanze hervor bringt (Ber. d. Deut. Bot. Ges., Bd. XII, Heft 1, 1894).

TABLE 10.—*Showing arrangement of the trees and methods of treating pear seedlings.*

Plat.	Kind of seedlings.	Tree numbers.	Remarks.
1	Japan	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Untreated.
2	French	11, 12, 13, 14, 15, 16, 17, 18, 19, 20	Do.
3	Japan	21, 22, 23, 24, 25, 26, 27, 28, 29, 30	Treated.
4	French	31, 32, 33, 34, 35, 36, 37, 38, 39, 40	Do.
5	Japan	41, 42, 43, 44, 45, 46, 47, 48, 49, 50	Untreated.
6	French	51, 52, 53, 54, 55, 56, 57, 58, 59, 60	Do.
7	Japan	61, 62, 63, 64, 65, 66, 67, 68, 69, 70	Treated.
8	French	71, 72, 73, 74, 75, 76, 77, 78, 79, 80	Do.
9	Japan	81, 82, 83, 84, 85, 86, 87, 88, 89, 90	Untreated.
10	French	91, 92, 93, 94, 95, 96, 97, 98, 99, 100	Do.
11	Japan	101, 102, 103, 104, 105, 106, 107, 108, 109, 110	Treated.
12	French	111, 112, 113, 114, 115, 116, 117, 118, 119, 120	Do.
13	Japan	121, 122, 123, 124, 125, 126, 127, 128, 129, 130	Untreated.
14	French	131, 132, 133, 134, 135, 136, 137, 138, 139, 140	Do.
15	Japan	141, 142, 143, 144, 145, 146, 147, 148, 149, 150	Treated.
16	French	151, 152, 153, 154, 155, 156, 157, 158, 159, 160	Do.
17	Japan	161, 162, 163, 164, 165, 166, 167, 168, 169, 170	Untreated.
18	French	171, 172, 173, 174, 175, 176, 177, 178, 179, 180	Do.
19	Japan	181, 182, 183, 184, 185, 186, 187, 188, 189, 190	Treated.
20	French	191, 192, 193, 194, 195, 196, 197, 198, 199, 200	Do.

Bordeaux mixture, consisting of 6 pounds of copper sulphate, 4 pounds of lime, and 45 gallons of water, was used throughout the experiment, five applications in all being made, the first on May 24, the second on June 7, the third on June 20, the fourth on July 6, and the fifth on July 25.

RESULTS OF THE EXPERIMENT.

The records made as regards weight, height, and size of the seedlings previous to planting are set forth in the following table:

TABLE 11.—*Showing weight, height, and size of pear seedlings previous to planting.*

No. of seedling.	Kind of seedling.	Kind of treatment.	Weight.	Total height.	Height above ground.	Caliper at collar.	Caliper one-half way up tree.
			Ounces.	*Inches.*	*Inches.*	*Inch.*	*Inch.*
1	Japan	Untreated	1.0	22½	9½	5/16	5/16
2	....do	....do	0.8	19½	10	5/16	1/4
3	....do	....do	1.6	22½	10	7/16	7/16
4	....do	....do	1.0	21	10½	5/16	1/4
5	....do	....do	0.9	24	11½	5/16	5/16
6	....do	....do	0.8	19	10	5/16	5/16
7	....do	....do	0.9	20	9½	5/16	5/16
8	....do	....do	0.6	19½	9	1/4	1/4
9	....do	....do	0.7	18½	10	5/16	1/4
10	....do	....do	0.8	18	9	5/16	1/4
11	French	....do	1.2	15½	8	3/8	1/8
12	....do	....do	1.1	17½	10	5/16	1/4
13	....do	....do	0.8	15	9	5/16	1/8
14	....do	....do	0.9	15½	9½	5/16	1/4
15	....do	....do	1.2	17	11½	5/16	5/16
16	....do	....do	0.7	14½	8½	5/16	1/4
17	....do	....do	0.6	14½	8½	5/16	1/4
18	....do	....do	1.2	16	10½	5/16	5/16
19	....do	....do	0.5	15	10½	5/16	5/16
20	....do	....do	0.6	16½	11	5/16	1/8
21	Japan	Treated	0.9	17½	8	5/16	1/4
22	....do	....do	0.5	19½	9½	5/16	5/16
23	....do	....do	0.9	19	7¾	3/8	1/4
24	....do	....do	0.9	21	9	5/16	5/16
25	....do	....do	1.0	24	13	5/16	1/4
26	....do	....do	1.2	19½	9½	1/2	5/16
27	....do	....do	0.9	21½	8½	3/8	3/8

TABLE 11.—*Showing weight, height, and size of pear seedlings, etc.*—Continued.

No. of seedling.	Kind of seedling.	Kind of treatment.	Weight.	Total height.	Height above ground.	Caliper at collar.	Caliper one-half way up tree.
			Ounces.	*Inches.*	*Inches.*	*Inch.*	*Inch.*
28	Japan	Treated	1.3	18⅛	9½	⅜	¼
29	....do	....do	0.8	16	7⅞	¼	3/32
30	....do	....do	0.6	18½	8⅜	¼	3/32
31	French	....do	1.3	17	10	3/16	3/32
32	....do	....do	1.2	17	10	3/16	1/16
33	....do	....do	1.7	17	10½	7/16	⅛
34	....do	....do	0.9	16⅜	11	3/16	¼
35	....do	....do	0.5	15½	10	¼	1/16
36	....do	....do	0.7	15	9½	7/16	3/32
37	....do	....do	1.7	16	10	7/16	1/32
38	....do	....do	0.7	13½	8¼	⅜	¼
39	....do	....do	1.1	14½	10½	7/16	1/16
40	....do	....do	1.7	16½	11¼	1/2	3/32
41	Japan	Untreated	1.3	25	12	7/16	3/32
42	....do	....do	0.9	21	9½	⅜	¼
43	....do	....do	0.8	22	11½	7/16	3/32
44	....do	....do	0.9	21½	10½	⅜	¼
45	....do	....do	0.8	21⅛	11	3/32	¼
46	....do	....do	0.9	19	9¼	7/16	¼
47	....do	....do	1.3	20½	10⅜	⅜	¼
48	....do	....do	1.2	19	9½	7/16	3/32
49	....do	....do	1.0	20½	10⅜	⅜	¼
50	....do	....do	0.8	20	8⅜	7/16	3/32
51	French	....do	1.2	17½	11	⅜	¼
52	....do	....do	0.6	13	7⅜	3/16	1/16
53	....do	....do	0.6	15	9½	7/16	3/32
54	....do	....do	0.9	16	11	3/16	¼
55	....do	....do	0.7	15	8	7/16	¼
56	....do	....do	0.8	15½	9	7/16	¼
57	....do	....do	1.3	16	11	7/16	¼
58	....do	....do	0.9	14½	9	⅜	¼
59	....do	....do	0.8	14	9	1/2	¼
60	....do	....do	0.6	14½	9	7/16	3/32
61	Japan	Treated	0.6	19	8½	⅜	1/16
62	....do	....do	0.7	16	8½	⅜	¼
63	....do	....do	1.2	20	9	⅜	¼
64	....do	....do	1.0	21	11	7/16	1/16
65	....do	....do	1.1	22	10	1/2	¼
66	....do	....do	1.0	18	7⅜	3/32	¼
67	....do	....do	1.0	19	10	⅜	1/16
68	....do	....do	0.8	16	8½	⅜	¼
69	....do	....do	1.2	19	9	1/2	¼
70	....do	....do	1.2	20	9	⅜	¼
71	French	....do	1.6	17	11	3/32	1/16
72	....do	....do	0.9	16	10	7/16	¼
73	....do	....do	1.0	17	11	3/16	¼
74	....do	....do	0.9	16½	10	⅜	¼
75	....do	....do	0.8	15	9½	7/16	¼
76	....do	....do	0.7	14½	9½	7/16	¼
77	....do	....do	0.7	16	10	3/32	3/32
78	....do	....do	0.3	15½	10½	¼	1/16
79	....do	....do	0.7	13½	7⅞	1/2	¼
80	....do	....do	1.0	16½	11	3/32	¼
81	Japan	Untreated	1.2	20½	10½	⅜	3/32
82	....do	....do	0.9	19	8½	⅜	¼
83	....do	....do	0.6	18	7	¼	1/16
84	....do	....do	0.8	17	7⅜	3/16	3/32
85	....do	....do	0.7	23	11⅛	7/16	1/16
86	....do	....do	0.5	17	6½	7/16	3/32
87	....do	....do	0.5	14½	9	3/32	1/16
88	....do	....do	0.6	19½	10	3/16	3/32
89	....do	....do	0.4	15	8	7/16	¼
90	....do	....do	0.8	14	7⅜	7/16	¼
91	French	....do	0.5	17	11½	¼	1/16
92	....do	....do	0.8	16	10	7/16	¼
93	....do	....do	1.1	16	11	⅜	3/32
94	....do	....do	1.0	16	11	7/16	¼
95	....do	....do	1.7	16½	12	1/2	3/32
96	....do	....do	1.9	17⅛	12	1/2	3/32
97	....do	....do	0.7	14½	10	7/16	¼
98	....do	....do	1.1	15½	10½	3/32	3/32
99	....do	....do	1.0	16	10½	⅜	3/32
100	....do	....do	0.9	17⅜	11½	7/16	¼
101	Japan	Treated	0.8	21	9	3/32	3/32

TABLE 11.—*Showing weight, height, and size of pear seedlings, etc.*—Continued.

No. of seedling.	Kind of seedling.	Kind of treatment.	Weight.	Total height.	Height above ground.	Caliper at collar.	Caliper one-half way up tree.
			Ounces.	*Inches.*	*Inches.*	*Inch.*	*Inch.*
102	Japan	Treated	1.1	22	9	5/16	1/4
103	....do	....do	0.9	21½	9	5/16	3/16
104	....do	....do	0.8	19	8½	3/16	1/4
105	....do	....do	0.8	21½	8½	1/4	1/4
106	....do	....do	0.8	19½	11½	1/4	1/16
107	....do	....do	0.9	23	10½	5/16	1/4
108	....do	....do	0.6	20	10	3/16	1/4
109	....do	....do	0.6	20	9	3/16	3/16
110	....do	....do	0.6	22	9	1/4	3/16
111	French	....do	1.0	15½	10	5/16	1/16
112	....do	....do	0.9	16½	10½	1/4	1/4
113	....do	....do	1.0	16	8½	5/16	1/4
114	....do	....do	1.0	16	9	1/4	3/16
115	....do	....do	0.9	16	10	5/16	1/4
116	....do	....do	1.3	17	8½	5/16	1/4
117	....do	....do	0.5	17	11	1/4	1/4
118	....do	....do	0.9	17	10	5/16	1/16
119	....do	....do	1.6	18½	11½	5/16	1/4
120	....do	....do	1.9	17½	9½	5/16	1/16
121	Japan	Untreated	0.5	20½	7½	1/16	1/8
122	....do	....do	0.7	21	10	1/4	1/16
123	....do	....do	0.6	17½	9	1/4	3/16
124	....do	....do	0.6	16½	9	3/16	3/16
125	....do	....do	0.7	20	10½	1/4	1/16
126	....do	....do	0.5	18	6½	1/16	1/16
127	....do	....do	0.9	19½	10	1/16	1/4
128	....do	....do	0.7	17½	9½	5/16	3/16
129	....do	....do	0.5	20	8½	1/4	3/16
130	....do	....do	0.9	18	10½	1/4	3/16
131	French	....do	0.6	17	9½	1/16	3/16
132	....do	....do	1.1	16	11	5/16	1/4
133	....do	....do	1.1	18	10	1/16	1/4
134	....do	....do	0.6	17	9½	5/16	1/4
135	....do	....do	0.9	17½	10	1/16	1/4
136	....do	....do	0.9	18	10	5/16	1/4
137	....do	....do	1.3	16½	9	1/16	1/4
138	....do	....do	1.0	16½	11	5/16	1/16
139	....do	....do	1.0	16½	9	5/16	1/4
140	....do	....do	0.7	17½	11	1/4	1/4
141	Japan	Treated	0.8	20½	10½	1/4	1/4
142	....do	....do	1.0	21	9½	5/16	3/16
143	....do	....do	0.6	20	9	5/16	3/16
144	....do	....do	1.0	18½	7	1/4	3/16
145	....do	....do	1.2	19½	9	5/16	1/4
146	....do	....do	1.0	20½	8½	1/4	1/4
147	....do	....do	0.9	18	10	5/16	3/16
148	....do	....do	0.7	20	9½	5/16	1/16
149	....do	....do	0.5	16½	7½	5/16	1/16
150	....do	....do	0.7	17½	8½	5/16	1/16
151	French	....do	0.9	16½	9	1/4	1/16
152	....do	....do	0.7	18	11½	5/16	1/16
153	....do	....do	0.7	17	9½	1/4	1/16
154	....do	....do	0.9	16	9½	1/4	3/16
155	....do	....do	0.5	16½	10½	1/4	1/4
156	....do	....do	1.0	15½	8½	5/16	3/16
157	....do	....do	0.6	14½	9½	1/4	3/16
158	....do	....do	1.0	17½	10	5/16	1/4
159	....do	....do	1.5	18½	11½	5/16	1/4
160	....do	....do	1.1	17	9½	5/16	1/16
161	Japan	Untreated	0.7	18	8½	1/4	1/4
162	....do	....do	0.6	18	9	3/16	3/16
163	....do	....do	0.5	16	8	1/4	3/16
164	....do	....do	0.6	20	9	1/4	3/16
165	....do	....do	0.9	17	8½	5/16	3/16
166	....do	....do	0.6	19½	9	5/16	1/4
167	....do	....do	0.6	17	10	5/16	3/16
168	....do	....do	0.7	20	9	5/16	3/16
169	....do	....do	0.7	19½	8	5/16	3/16
170	....do	....do	0.8	21	9½	3/16	3/16
171	French	....do	1.0	17	10	1/4	3/16
172	....do	....do	1.2	18	10½	5/16	1/4
173	....do	....do	1.0	18	11	5/16	1/4
174	....do	....do	0.9	17½	11	5/16	1/4
175	....do	....do	0.9	16	10	5/16	1/4

TABLE 11.—*Showing weight, height, and size of pear seedlings, etc.*—Continued.

No. of seedling.	Kind of seedling.	Kind of treatment.	Weight.	Total height.	Height above ground.	Caliper at collar.	Caliper one-half way up tree.
			Ounces.	*Inches.*	*Inches.*	*Inch.*	*Inch.*
176	French	Untreated	0.6	17¼	10	1/4	3/32
177	do	do	1.0	17	9	1/4	1/4
178	do	do	0.9	17½	10½	5/32	3/32
179	do	do	1.1	14½	8	1/4	3/32
180	do	do	1.1	18	10	1/4	3/32
181	Japan	Treated	0.8	21	10½	1/4	3/32
182	do	do	0.8	19½	8⅝	5/32	3/32
183	do	do	0.6	17¾	8½	3/32	3/32
184	do	do	0.7	19	9	5/32	1/4
185	do	do	0.7	18	8⅝	3/32	3/32
186	do	do	0.7	19	8	1/4	5/32
187	do	do	0.7	20	9⅛	3/32	5/32
188	do	do	0.9	21	12	5/32	5/32
189	do	do	0.5	20	9	1/4	5/32
190	do	do	0.6	19½	8½	5/32	3/32
191	French	do	1.0	17	10½	5/32	3/32
192	do	do	1.2	17	9½	5/32	3/32
193	do	do	1.5	17	9	3/16	3/32
194	do	do	0.7	16½	9½	3/32	3/32
195	do	do	0.8	18	10½	5/32	3/32
196	do	do	1.5	17½	10½	3/16	5/32
197	do	do	0.9	16½	9½	5/32	5/32
198	do	do	1.1	16	10	1/4	1/4
199	do	do	1.7	18	12	3/16	5/32
200	do	do	0.9	15	9	3/16	1/8

It will be seen from the foregoing table that the weight of the Japan trees varied from $\frac{5}{10}$ of an ounce to $1\frac{6}{10}$ ounces, the average being $\frac{8}{10}$ of an ounce. The weight of the French trees varied from $\frac{3}{10}$ of an ounce to $1\frac{9}{10}$ ounces, the average being 1 ounce. The height above ground of the Japan trees varied from 7 to 13 inches and averaged 9 inches. The French ranged in height from 7 to 12 inches and averaged 10 inches. The average caliper of the Japan at the ground was $\frac{5}{16}$ of an inch, while for the French it was $\frac{11}{32}$ of an inch. It will be seen that while the averages of the two kinds of stock were close, the French stood a little higher in this respect throughout. On June 2, the time of the second spraying, both the French and Japan stocks had started nicely. No disease whatever had appeared up to this time. Between June 7 and June 20 leaf blight appeared on many of the untreated trees, the French and Japan both being affected alike. After June 20 the disease increased very rapidly on the untreated trees, but did very little damage to the treated. The average height of the Japan seedlings at this time was 30 to 36 inches, while for the French it was only 15 to 18 inches. As the summer advanced the disease grew more and more severe, and by the 1st of September many of the untreated trees were totally defoliated. All of the treated trees held their foliage until frost, the Japan showing better results in this respect than the French seedlings. The trees were allowed to stand in the nursery rows until April 10, 1894, when they were dug, packed, and shipped to Washington, to be weighed and measured in exactly the same way as was done before planting. The

weights, measurements, etc., made at this time will be found in the following table:

TABLE 12.—*Showing weight and size of Japan and French pear stocks April 10, 1894, after treating for one season.*

No. of seedling.	Kind of seedling.	Kind of treatment.	Weight.	Total height.	Height above ground.	Caliper at collar.	Caliper one-half way up tree.
			Ounces.	*Inches.*	*Inches.*	*Inch.*	*Inch.*
1	Japan	Untreated	1.5	27	16	5/16	1/4
2	....do	.....do	5.5	34	26	7/16	1/4
3	....do	.....do	4	30	21	1/4	1/4
4	....do	.....do	1.5	24	13	1/4	1/4
5	....do	.....do	7	44	34	5/16	1/4
6	....do	.....do	8.5	48	36	11/16	5/16
7	....do	.....do	11	54	42	13/16	7/16
8	....do	.....do	3.5	42	30	1/2	1/4
9	....do	.....do	9	56	45	5/8	1/4
10	....do	.....do	4.5	42	30	11/16	1/4
11	French	.....do	1	20	14	5/16	1/4
12	....do	.....do	2	27	19	3/8	1/4
13	....do	.....do	2	25	18	3/8	1/4
14	....do	.....do	1.5	20	12	3/8	1/4
15	....do	.....do	1.5	17	11	3/8	1/4
16	....do	.....do	1.5	16	9	3/8	1/4
17	....do	.....do	3	30	22	5/16	5/16
18	....do	.....do	2	22	15	3/8	1/4
19	....do	.....do	1	15	10	1/4	1/4
20	....do	.....do	2.5	33	24	5/16	1/4
21	Japan	Treated	14	63	48	15/16	5/16
22	....do	.....do	11.5	40	27	13/16	7/16
23	....do	.....do	7.5	46	36	5/8	5/16
24	....do	.....do	12.5	51	38	13/16	7/16
25	....do	.....do	2	33	24	3/8	1/4
26	....do	.....do	19.5	53	40	13/16	1/2
27	....do	.....do	10	54	42	1/2	1/4
28	....do	.....do	12	57	45	11/16	5/16
29	....do	.....do	12	45	30	5/8	5/16
30	....do	.....do	10.5	45	34	5/8	5/16
31	French	.....do	3.5	40	30	7/16	5/16
32	....do	.....do	4	51	39	1/2	5/16
33	....do	.....do	4	36	27	1/2	1/4
34	....do	.....do	2.5	37	30	5/16	1/4
35	....do	.....do	1	30	22	1/4	5/16
36	....do	.....do	2	26	18	5/16	1/4
37	....do	.....do	4.5	36	29	1/2	1/4
38	....do	.....do	1	15	10	3/8	1/4
39	....do	.....do	1	14	9	3/8	1/4
40	....do	.....do	6.5	43	36	5/8	5/16
41	Japan	Untreated	16	48	36	5/8	1/2
42	....do	.....do	10.5	55	43	3/4	5/16
43	....do	.....do	6.5	61	50	5/8	7/16
44	....do	.....do	9	63	50	5/8	1/2
45	....do	.....do	5	43	33	9/16	5/16
46	....do	.....do	11.5	60	50	3/4	7/16
47	....do	.....do	7	54	43	3/4	5/16
48	....do	.....do	8	54	42	9/16	1/2
49	....do	.....do	8	56	44	5/8	1/2
50	....do	.....do	4	46	36	1/2	5/16
51	French	.....do	3	37	30	3/8	5/16
52	....do	.....do	1.5	18	11	5/16	1/4
53	....do	.....do	1	22	14	5/16	1/4
54	....do	.....do	1.5	21	14	3/8	5/16
55	....do	.....do	1	21	14	1/4	1/4
56	....do	.....do					
57	....do	.....do	2.5	32	24	5/16	1/4
58	....do	.....do	1.5	15	9	5/16	1/4
59	....do	.....do	1	17	12	5/16	1/4
60	....do	.....do	1.5	23	15	5/16	1/4
61	Japan	Treated	13	51	42	13/16	7/16
62	....do	.....do	2	33	24	5/16	5/16
63	....do	.....do	11.5	53	42	1/2	1/2
64	....do	.....do	4.5	43	33	5/16	1/4
65	....do	.....do	9.5	48	60	1/2	1/2
66	....do	.....do	8.5	50	39	1/2	1/2
67	....do	.....do	5	33	24	1/2	5/16
68	....do	.....do	10	51	36	1/2	7/16

TABLE 12.—*Showing weight and size of Japan and French pear stocks, etc.*—Continued

No. of seedling.	Kind of seedling.	Kind of treatment.	Weight.	Total height.	Height above ground.	Caliper at collar.	Caliper one-half way up tree.
			Ounces.	*Inches.*	*Inches.*	*Inch.*	*Inch.*
69	Japan	Treated	26.5	60	48	7/8	7/16
70	do	do	10.5	61	48	1 1/8	1/2
71	French	do	2	24	16	1/4	1/8
72	do	do	1.5	27	22	7/16	1/8
73	do	do	1.5	23	16	3/8	1/8
74	do	do	1.5	18	11	7/16	1/4
75	do	do	3.5	39	30	7/8	1/2
76	do	do	1	15	11	1/8	1/4
77	do	do					
78	do	do	1	24	18	5/16	1/8
79	do	do	1.5	34	26	7/16	1/8
80	do	do	5	48	39	1/2	1/16
81	Japan	Untreated	22.5	67	54	1 1/8	3/8
82	do	do	5.5	48	36	5/8	1/16
83	do	do	2.5	33	24	3/8	1/8
84	do	do	2	31	22	3/8	1/8
85	do	do	4.5	42	30	7/8	1/16
86	do	do	6	52	42	1/8	1/4
87	do	do	9.5	48	34	3/4	3/8
88	do	do		60	51		
89	do	do	8	60	51	5/8	7/16
90	do	do	10.5	61	52	5/8	7/16
91	French	do	1	23	15	1/4	1/16
92	do	do	2.5	36	30	3/8	1/16
93	do	do	2	30	24	5/8	1/4
94	do	do	2	30	22	1/8	1/16
95	do	do	2	25	19	3/8	1/4
96	do	do	3	29	23	7/16	1/16
97	do	do	1	15	10	5/16	1/4
98	do	do	1.5	25	17	3/8	1/4
99	do	do	3.5	38	27	3/8	1/4
100	do	do	3	40	30	3/8	1/4
101	Japan	Treated	20.5	62	48	7/8	3/8
102	do	do	12.5	46	36	3/4	7/16
103	do	do					
104	do	do					
105	do	do	6	54	38	1/2	5/16
106	do	do	2.5	48	36	1/2	1/4
107	do	do	4.5	39	30	1/2	3/8
108	do	do					
109	do	do					
110	do	do	13.5	60	46	3/4	3/8
111	French	do	3	43	33	1/4	3/8
112	do	do	1	20	12	5/16	1/4
113	do	do	1.5	20	12	3/8	1/4
114	do	do	3	42	32	7/16	1/4
115	do	do	1.5	25	17	7/16	1/4
116	do	do	3.5	50	38	1/2	1/4
117	do	do					
118	do	do	1.5	21	13	5/16	1/4
119	do	do	3.5	45	36	7/16	5/16
120	do	do	5.5	51	39	1/2	3/8
121	Japan	Untreated	1	29	16	1/4	1/4
122	do	do	6.5	45	33	9/16	5/16
123	do	do	4	36	26	1/2	3/8
124	do	do	3.5	54	42	1/2	5/16
125	do	do	3.5	55	46	7/16	1/4
126	do	do					
127	do	do	7	38	26	1/2	3/8
128	do	do	3.5	46	36	1/2	5/16
129	do	do					
130	do	do					
131	French	do					
132	do	do	2.5	35	27	3/8	1/4
133	do	do	4	45	36	3/8	5/16
134	do	do	1.5	22	14	5/16	1/4
135	do	do	1	25	16	7/16	1/4
136	do	do	1.5	25	17	3/8	1/4
137	do	do	2.5	34	24	7/16	1/4
138	do	do	1.5	25	17	5/16	1/4
139	do	do	2	34	25	3/8	5/16
140	do	do	1	19	12	7/16	1/4
141	Japan	Treated	17.5	65	54	13/16	7/16
142	do	do	20	60	49	13/16	7/16

TABLE 12.—*Showing weight and size of Japan and French pear stocks, etc.*—Continued.

No. of seedling.	Kind of seedling.	Kind of treatment.	Weight.	Total height.	Height above ground.	Caliper at collar.	Caliper one-half way up tree.
			Ounces.	*Inches.*	*Inches.*	*Inch.*	*Inch.*
143	Japan	Treated	3.5	36	24	1/2	1/4
144	....do	....do	9	48	36	3/8	1/4
145	....do	....do	8.5	48	40	1/2	5/16
146	....do	....do	9	50	40	3/8	5/16
147	....do	....do					
148	....do	....do	8.5	42	30	11/16	5/16
149	....do	....do	8	50	36	1/2	3/8
150	....do	....do					
151	French	....do	1.5	34	26	5/16	5/16
152	....do	....do	2	28	20	1/2	1/4
153	....do	....do	1	20	12	5/16	5/16
154	....do	....do	1.5	28	20	3/8	1/4
155	....do	....do	1	26	18	3/8	1/4
156	....do	....do	1.5	17	11	3/8	1/4
157	....do	....do	1	19	15	5/16	5/16
158	....do	....do	2	40	32	3/8	1/4
159	....do	....do	2	23	16	7/16	5/16
160	....do	....do	2.5	30	21	7/16	5/16
161	Japan	Untreated					
162	....do	....do	1	18	10	5/16	1/4
163	....do	....do	2	29	22	3/8	1/4
164	....do	....do	10.5	57	46	1/2	5/16
165	....do	....do	5	49	39	3/8	3/8
166	....do	....do	6.5	43	34	3/4	5/16
167	....do	....do	4	45	36	1/2	5/16
168	....do	....do	9	59	48	3/8	3/8
169	....do	....do	3	48	39	7/16	1/4
170	....do	....do	2.5	34	24	3/8	5/16
171	French	....do	2	27	20	5/16	1/4
172	....do	....do	4	39	27	7/16	1/4
173	....do	....do	2	39	30	5/16	5/16
174	....do	....do					
175	....do	....do	1.5	25	18	5/16	1/4
176	....do	....do	1.5	25	18	5/16	1/4
177	....do	....do	1	17	10	3/8	1/4
178	....do	....do					
179	....do	....do	5	38	30	1/2	1/4
180	....do	....do	1.5	21	13	3/8	1/4
181	Japan	Treated	15.5	63	51	1/2	3/8
182	....do	....do	11	54	42	3/8	5/16
183	....do	....do	4	42	28	1/2	1/4
184	....do	....do	10	57	45	7/16	1/4
185	....do	....do	8	46	36	1/2	3/8
186	....do	....do	8.5	42	32	11/16	3/8
187	....do	....do	9.5	46	36	3/8	5/16
188	....do	....do					
189	....do	....do	8	48	38	9/16	5/16
190	....do	....do	4.5	54	42	1/2	1/4
191	French	....do	2	33	25	3/8	5/16
192	....do	....do	3	35	24	1/2	5/16
193	....do	....do	4	43	34	1/2	3/8
194	....do	....do	1	26	19	5/16	5/16
195	....do	....do	1.5	34	24	5/16	5/16
196	....do	....do	2.5	36	24	7/16	5/16
197	....do	....do	2	30	23	3/8	5/16
198	....do	....do	3	38	30	7/16	1/4
199	....do	....do	3.5	34	24	1/2	3/8
200	....do	....do	2	27	20	3/8	1/4

A comparison of the figures in the foregoing table with those in table No. 11 brings out many points of interest. Take, for example, the first block of 10 untreated Japan seedlings. It will be seen that the weight of these trees before planting ranged from $\frac{6}{10}$ of an ounce to $1\frac{6}{10}$ ounces, the average being $\frac{9}{10}$ of an ounce. After growing one season, the same trees weighed from $1\frac{5}{10}$ of an ounce to 9 ounces, the average being $5\frac{6}{10}$ ounces. The next plat of Japan seedlings, which were treated, ranged

in weight, before planting, from $\frac{5}{10}$ of an ounce to $1\frac{3}{10}$ ounces, the average being $\frac{9}{10}$ ounce. These trees, after being treated one season with Bordeaux mixture, ranged in weight from 2 to $19\frac{5}{10}$ ounces, the average being $11\frac{2}{10}$. In other words, there was a gain of 1,133 per cent in the weight of the treated trees and 522 per cent in the untreated, a difference of 611 per cent in favor of the former.

In the following table is given the average weight of the trees in each plat before and after treatment, together with the per cent of increase of weight in each case:

TABLE 13.—*Showing treatment and average weight of trees before and after treatment.*

Plat.	Kind of seedling.	Kind of treatment.	Average weight of trees before treatment.	Average weight of trees after treatment.	Increase in weight of trees.
			Ounces.	*Ounces.*	*Per cent.*
1	Japan	Untreated	0.9	5.6	522
2	French	do	0.9	1.8	100
3	Japan	Treated	0.9	11.2	1,133
4	French	do	1.2	3	150
5	Japan	Untreated	1.0	8.6	760
6	French	do	0.8	1.5	87
7	Japan	Treated	1.0	10.1	910
8	French	do	0.9	1.9	111
9	Japan	Untreated	0.7	7.1	914
10	French	do	1.1	2.2	100
11	Japan	Treated	0.8	6	650
12	French	do	1.1	2.4	118
13	Japan	Untreated	0.7	2.9	314
14	French	do	0.9	1.8	100
15	Japan	Treated	0.8	8.4	950
16	French	do	0.9	1.6	78
17	Japan	Untreated	0.7	4.4	529
18	French	do	1.0	1.9	90
19	Japan	Treated	0.7	1.9	1,029
20	French	do	1.1	2.5	127

A striking fact brought out by the experiment is the great vigor of the Japan seedlings. In all cases they made a much better growth than the French. The Japan seedlings as a whole weighed before planting 5 pounds $1\frac{4}{10}$ ounces, while the French weighed 6 pounds $2\frac{1}{10}$ ounces, a difference of 1 pound and $\frac{7}{10}$ ounce in favor of the French trees. The Japan trees after treatment weighed 45 pounds, while the French weighed 12 pounds 11 ounces, a difference in favor of the Japan stocks of 32 pounds 5 ounces. Comparing the treated trees as a whole in this way we have the following:

TABLE 14.—*Weight of Japan and French pear seedlings treated and untreated.*

	Lbs.	Oz.
Weight of 50 Japan seedlings before treatment, designed for control or no spraying	2	7.3
Weight of 50 Japan seedlings before treatment, designed to be sprayed	2	10.3
Weight of 50 Japan pear seedlings not sprayed after one season's growth	17	13
Weight of 50 Japan pear seedlings sprayed after one season's growth	27	3
Weight of 50 French seedlings before treatment, designed for control or no spraying	2	14.8
Weight of 50 French seedlings before treatment, designed to be sprayed	3	3.3
Weight of 50 French seedlings not sprayed after one season's growth	5	10

TABLE 14.—*Weight of Japan and French pear seedlings, etc.*—Continued.

	Lbs.	Oz.
Increase in weight of the 50 Japan trees treated over those not treated	9	6
Increase in weight of the 50 French trees treated over those not treated	1	7
Increase in weight of the 50 Japan trees over the 50 French trees not treated	12	3
Increase in weight of the 50 Japan trees treated over the 50 French trees treated	20	2

Aside from the facts noted in regard to weights, some interesting points are brought out by comparing the data bearing on height and caliper. In the matter of height the treated Japan trees averaged at the close of the experiment 43 inches, while the untreated averaged the same, thus showing that the increase in growth in this case was not in the direction of length. The French trees not treated averaged 24 inches in height, while the treated averaged 30 inches. In this particular case the Japan seedling proved superior to the French in all cases, as will be seen by a comparison of the second averages.

SUMMARY.

(1) Five applications of Bordeaux mixture had a decided effect on the growth of both Japan and French pear seedlings, increasing their weight, height, and caliper to a marked extent in almost every case.

(2) The Japan seedlings in all cases proved more vigorous than the French, but whether this would hold true in all sections of the country remains to be proved.